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(71) Applicant
Robert Bosch GmbH

(Incorporated in the Federal Republic of Germany)

W-7000 Stuttgart 30, Federal Republic of Germany

(72) Inventor
Jaroslaw Hlousek

(74) Agent and/or Address for Service
A A Thornton & Co
Northumberland House, 303-306 High Holborn,
London, WC1V 7LE, United Kingdom

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(56) Documents cited
US 4407457 A US 4202500 A

(58) Field of search
UK CL (Edition L) F1B
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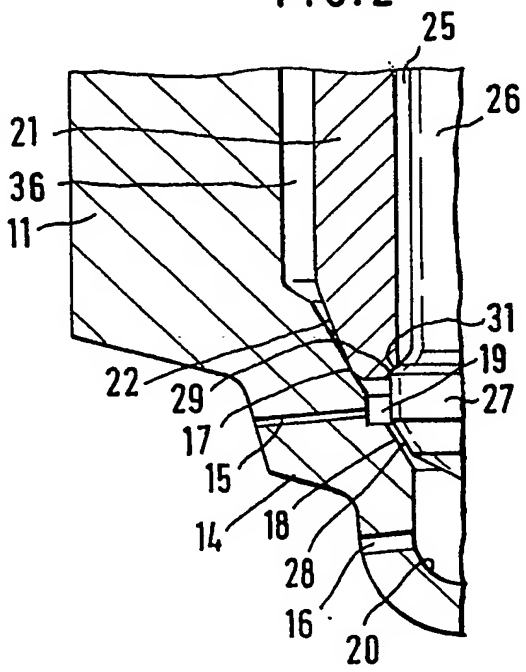
(54) Pre-injection and main injection i.c. engine fuel injector

(57) The valve head 27 lifts from the valve seat 31 on the hollow needle 21 and comes into sealing contact with a valve seat 18 in the nozzle body 11 to shut off the injection holes 16, pre-injection fuel then flowing via a chamber 19 through injection holes 16. The hollow needle 21 lifts from its valve seat 17, the valve needle 26 being lifted from the seat 18 thereby, so that fuel passes to injection holes 15 and 16 to provide the main injection. Respective injection pumps (48, 43, Fig. 1) provide the pre-injection and main fuel.

FIG.2



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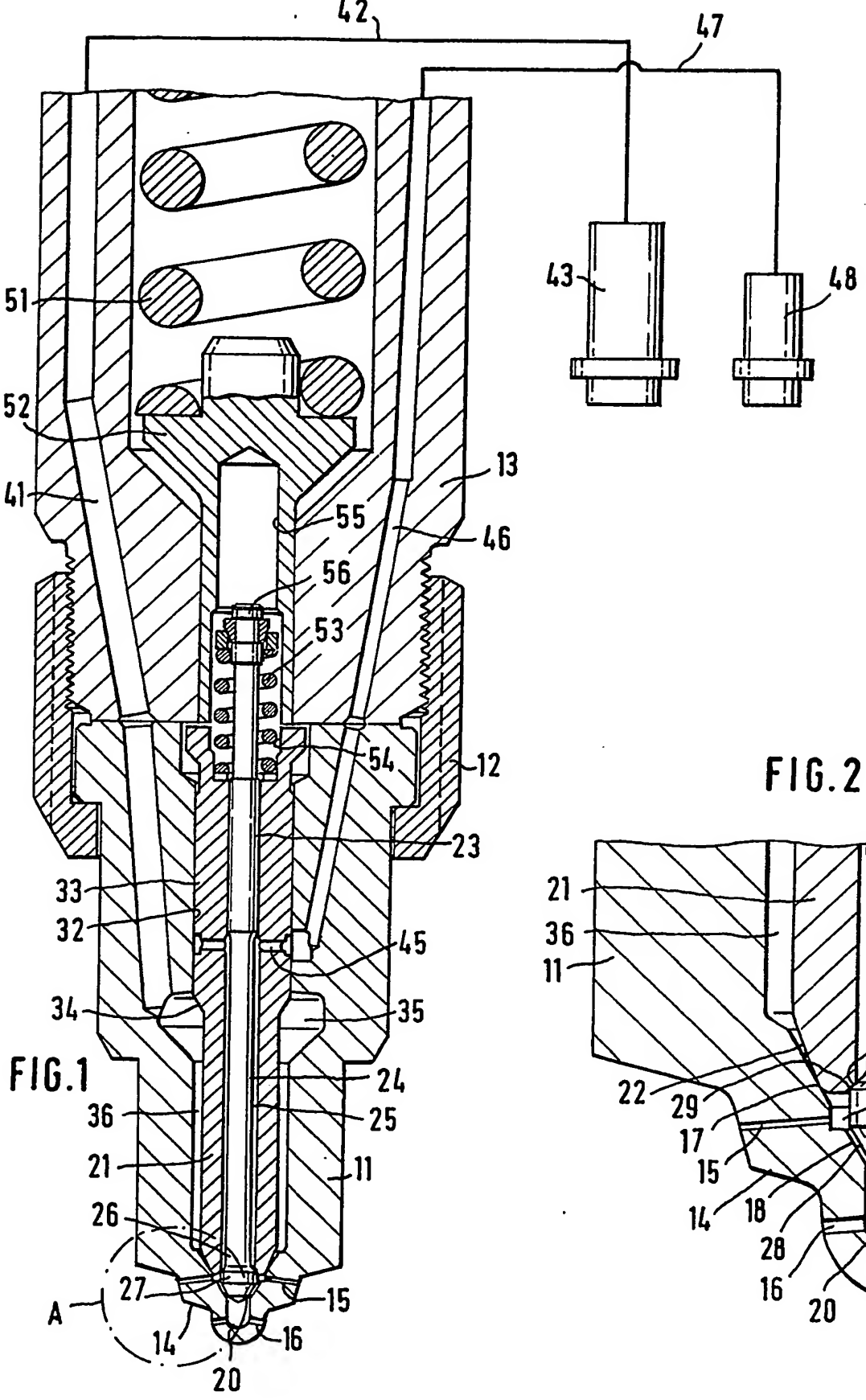

FIG.1

FIG.2

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Fuel injection nozzle for pre-injection and main injection

State of the art

The invention is based on a fuel injection nozzle of the generic type of Claim 1.

In such an injection nozzle, known for example from the Deutsche Offenlegungsschrift 18 08 650 (Figure 4), the hollow needle interacting with the first valve seat serves to control the pre-injection and the central valve needle with the closing head, which interacts with the valve seat on the hollow needle and lifts in the fuel flow direction, serves to control the main injection. The pre-injection takes place through injection holes in a mouthpiece at the combustion-space end of the nozzle body, the end section of the hollow needle downstream of its conical valve seat surface interacting with the first valve seat being guided in the said mouthpiece. The valve seat for the closing head opening towards the outside is also arranged in this end section so that the spray directions of the pre-injection jets and that of the main injection screening jet diverge strongly.

Advantages of the invention

The fuel injection nozzle according to the invention with the characterising features of Claim 1 has the advantage that due to the control of the main injection by means of the hollow needle, which accommodates the central valve needle for the pre-injection, fuel is injected simultaneously through the cross-section for pre-injection and through the cross-section for main injection into the compression space when the

hollow needle is raised from its valve seat, so that intensive fuel distribution and preparation is achieved in the compressed air in the combustion space.

Advantageous further developments and improvements to the fuel injection nozzle given in the main claim are possible by means of the measures listed in the sub-claims.

Drawing

An embodiment example of the invention is shown in the drawing and is explained in more detail below. Figure 1 shows, in longitudinal section, the part of a fuel injection nozzle which is at the combustion space end and Figure 2 shows, at an enlarged scale, a detail A of the fuel injection nozzle of Figure 1.

Description of the embodiment example

A nozzle body 11, which is fastened by a clamping nut 12 to a nozzle holder 13, has - in a tip 14 at the combustion space end - injection holes 15, 16 for pre-injection and main injection in two axially offset circles of holes directed into the combustion space of an internal combustion engine. A conical valve seat 17, 18 is respectively arranged in the nozzle body 11 upstream of each of these planes with the injection holes 15, 16 and these conical valve seats are separated from one another by an annular groove 19. The injection holes 15 for the pre-injection emerge from this annular groove 19 and the injection holes 16 emerge further downstream from a pocket hole 20 in the tip 14. Two coaxial valve needles, of which one is configured as a hollow needle 21 with a conical seating surface interacting with the valve seat 17, are displaceably arranged in the nozzle body 11. The other valve needle 26, which is guided coaxially so that it can slide in the hollow needle 21 by means of an inlet-end guide section 23 and bounds the supply passage 25 by means of a subsequent section 24 relieved in

diameter, carries a closing head 27 at its combustion space end. This closing head 27 has a conical seating surface 28 interacting with the valve seat 18 in the nozzle body 11 and a conical seating surface 29 facing away from the seating surface 28 and facing towards the shaft, which seating surface 29 interacts with a radially inner valve seat 31 at the combustion space end of the hollow needle 21, which valve seat 31 is arranged at approximately the same height as the seating surface 22 arranged radially outwards.

The inlet-end guide section 33 of the hollow needle 21 is supported so that it can slide in the upper part of the nozzle body 11 and is relieved in diameter, forming an annular gap 36, by means of a pressure shoulder 34 in the region of a pressure chamber 35 in the nozzle body 11. The pressure chamber 35 is connected to an injection pump 43 for main injection via a supply conduit 42 and an inlet passage 41 in the nozzle body 11 and in the nozzle holder 13. The supply passage 25 between the section of the hollow needle 21 at the combustion space end and the valve needle 26 is connected to an injection pump 48 for pre-injection by means of a supply conduit 47, radial penetrations 45 in the hollow needle 21 and an inlet passage 46 in the nozzle body 11 and in the nozzle holder 13.

By means of a pressure piece 52, a closing spring 51 in the nozzle holder 13 presses the seating surface 22 of the hollow needle 21, whose guide section 33 can be displaced in the guide hole 32 in the nozzle body 11, against the valve seat 17 in the nozzle body 11. A second closing spring 53, which is arranged in pocket holes 54, 55 aligned with one another in the hollow needle 21 and in the pressure piece 52 and which is supported on the bottom of the pocket hole 54 in the hollow needle 21, pulls on a head 56 at the inlet end of the valve needle 26 engaging the closing head 27 of the valve needle 26 against the inner valve seat 31 on the hollow needle 21.

The fuel injection nozzle described above operates as follows:

In the case of unpressurised inner passages 41 and 46, the closing spring 51 presses the seating surface 22 of the hollow needle 21 onto the valve seat 17 in the nozzle body 11 and the closing spring 53 pulls the seating surface 29 of the closing head 27 of the valve needle 26 against the valve seat 31 on the hollow needle 21 so that the connections to the injection holes 15, 16 are interrupted and the seating surface 28 on the combustion space end of the closing head 27 is raised from the valve seat 18 in the nozzle body 11.

In order to introduce and carry out the pre-injection, the injection pump 48 delivers a small quantity of fuel through the inner passage 46 and the penetrations 45 into the supply passage 55 [sic] so that the pressure acting on the closing head 27 displaces the valve needle 26 against the force of the closing spring 53, the seating surface 29 on the inlet end being lifted from the valve seat 31 on the hollow needle 21 and, after a relatively small stroke, the seating surface 28 at the combustion space end comes in contact with the valve seat 18 in the nozzle body 11. Fuel flowing through the valve gap between the valve seat 31 and the seating surface 29 and through the annular groove 19 penetrates through the narrow injection holes 15, which emerge from the annular groove 19, and is sprayed as jets into the combustion space. With decreasing pressure, the closing head 27 closes the connection to the pump 48 again; the pre-injection is ended.

Subsequently or after a certain pause, when the ignition in the combustion space sets in, the main injection pump 43 delivers fuel through the inlet passage 41 to the pressure space 35. The increasing pressure lifts the seating surface 22 of the hollow needle 21 from the valve seat 17 in the nozzle body 11, the valve needle 26 sealing the supply passage 25 by means

of its closing head 27 being taken along with it. Fuel flowing through the valve gaps between the valve seat 17 and the seating surface 22 of the hollow needle 21 and between the valve seat 18 and the seating surface 28 on the closing head 27 is sprayed into the combustion space through the injection holes 15 and 16 located both downstream of the valve seat 17 and downstream of the valve seat 18 with further distribution into the compressed air, which has been prepared in the best possible manner for ignition.

It should, in particular, also be noted that the valve with the valve seat 18 in the nozzle body 11 and the seating surface 28 on the closing head 27, which shuts off the connection to the main injection holes 16 located further downstream in the case of pre-injection, can also be configured as a flat seat valve. Furthermore, the injection cross-section formed by the main injection holes 16 can also be formed by an annular gap between a throttle pintle on the closing head 27 and a mouthpiece, surrounding the latter, on the nozzle body.

Claims

1. Fuel injection nozzle for the pre-injection and main injection in an air-compressing internal combustion engine, having a nozzle body with a first and a second valve seat, having a valve needle displaceably supported in a guide hole and configured as a hollow needle which, during the opening stroke, lifts from the first valve seat against the force of a first closing spring and against the fuel supply direction, and having a valve needle displaceable with radial clearance in the hollow needle as a supply passage and loaded by a second valve spring supported on the hollow needle, this latter valve needle having a closing head which, during the opening stroke of the valve needle, lifts from a third valve seat on the combustion space end of the hollow needle against the force of the second closing spring and in the fuel flow direction, characterised in that an annular groove (19) and, on it, a third valve seat (18) in the nozzle body (11) follow on in the fuel flow direction downstream of the first valve seat (17), in that injection holes (15) for the pre-injection emerge from the annular groove (19), and in that the closing head (27) is in contact in a second position on the third valve seat (18) in the case of pressure build-up in the fuel supply passage (25) so that the injection holes (15) for the pre-injection are connected via the annular groove (19) to the fuel supply passage (25).

2. Fuel injection nozzle according to Claim 1, characterised in that the second valve seat (31), on the hollow needle (21), interacting with the closing head (27) of the valve needle (26) is arranged radially inwards approximately at the same height as the

radially outer seating surface (22) of the hollow needle (26) interacting with the first valve seat (17) in the nozzle body (11).

3. Fuel injection nozzle according to Claim 1 or 2, characterised in that the injection cross-section located downstream of the annular groove (19) and of the valve seat (18), in the nozzle body (11), following on downstream of the annular groove (19) is configured as injection holes (16) in a tip (14) on the nozzle body (11).

4. A fuel injection nozzle substantially as herein described with reference to the accompanying drawing.

Examiner's report to the Comptroller under Section 17 (The Search Report)

GB 9307480.5

Relevant Technical fields

(i) UK Cl (Edition L) F1B

(ii) Int Cl (Edition 5) F02M 45/08, 61/18

Search Examiner

R J DENNIS

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search

10 MAY 1993

Documents considered relevant following a search in respect of claims 1-4

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	US 4407457 (MAN)	1-3
Y	US 4202500 (BOSCH) See particularly Figures 1 and 2	1-3

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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